CHAPTER 8

# Grassland Communities

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## Description

In this document, the term *grassland* refers collectively to several native Wisconsin plant communities. These include prairie, brush prairie (i.e., prairie with oak grubs and shrubs less than six feet tall), sand barrens, bracken-grassland, fen, and sedge meadow (southern and northern) as defined by Curtis (1959). Common characteristics of these communities are (1) lack of trees and tall shrubs and (2) dominance by graminoid (grass and sedge) species.

Prairie (French for "meadow") was the only word early French explorers had to describe the extensive, treeless, and grass-covered landscapes of central North America. Prairie subsequently became the term used to describe the grassland type most prevalent in Wisconsin prior to Euro-American settlement.

Wisconsin's grasslands are at the periphery of North America's extensive mid-continental grassland biome which lies south and west of the state. Historically, Wisconsin grasslands were maintained primarily by frequent fires, as was most of the North American grassland biome.

Treelessness is generally the optimum state for maximum development and health of these grassland systems. Although grasses and sedges dominate vegetative biomass in this community type, forbs (non-graminoid wildflowers) dominate the species composition. The most represented families of forbs are the composite (aster), legume, milkweed, carrot, and rose families. Over 400 species of native vascular plants are characteristic of Wisconsin grasslands, and most of these are restricted to grassland or grassland/savanna communities. Detailed descriptions of Wisconsin's grassland plant communities can be found in the classic text by Curtis (1959). Wisconsin grasslands also have a diverse and specialized fauna, especially among the invertebrates, herptiles, and birds.

*Prairie* (French for "meadow") was the only word early French explorers had to describe the extensive, treeless, and grass-covered landscapes of central North America. *Prairie* subsequently became the term used to describe the grassland type most prevalent in Wisconsin prior to Euro-American settlement. Prairie in Wisconsin was located mostly in the southern and western parts of the state. It occurred across a wide range of topographies, soil types, and soil moisture regimes. This variety of edaphic conditions resulted in a great diversity of prairie flora.

*Fen* is a highly restricted type of wet prairie that supports an unusually special-

ized flora. It forms on wet to moist and often peaty, calcareous soils that have developed over a diffuse groundwater discharge area that is often under artesian pressure.

*Sedge meadow* is at the extreme wet end of the prairie continuum and was the second most common grassland type in the state. It is distinguished from wet prairie by having (1) more sedge than grass vegetation, (2) more organic than mineral soil, and (3) seasonally standing water. It also supports a less diverse flora than wet prairie.

*Bracken-grassland* was the northern version of prairie and was found mostly north of the tension zone, which is a band 10-30 miles wide, running from the northwest to southeast corners of the state, separating the two major floristic provinces of Wisconsin (Curtis 1959). It was not abundant historically. Although similar to prairie in structure, bracken-grassland is floristically very different (Curtis 1959:314-21), with bracken fern being a dominant species. This limited vegetation type is covered in the "Oak and Pine Barrens" section.

*Sand barrens* is also a limited grassland type. It is similar to dry sand prairie, but has far sparser vegetation, and it generally includes exposed sand or sandblows. Most sand barrens today are artifacts of post-Euro-American-settlement activity, primarily failed attempts at agriculture.

Northern sedge meadow in Douglas County. Structurally, sedge meadow is a grassland but hydrologically, it is a wetland. *Photo by Eric Epstein.*

## Status

### Past

North America's mid-continental grasslands have been in existence for millions of years. Originating in the rain shadow that developed with the uplifting of the Rocky Mountains, they have been expanding and contracting with major climatic changes ever since. They made their most recent incursion into what is now Wisconsin approximately five to six thousand years ago and remained relatively stable here until Euro-American settlement in the mid-1800s. Original land survey records of the 1830s indicate there were 3.1 million acres of treeless grassland in Wisconsin, or 9% of the total land cover (Curtis 1959). A little over two-thirds of this open land (2.1 million acres) was prairie, and approximately one-third (1 million acres) was sedge meadow (see Fig. 10).

North America's mid-continental grasslands have been in existence for millions of years . . . . Original land survey records of the 1830s indicate there were 3.1 million acres of treeless grassland in Wisconsin, or 9% of the total land cover (Curtis 1959) . . . . Tallgrass prairie and related oak savanna are now the most decimated and threatened plant communities in the Midwest and in the world.

### Present

Over the past 150 years, the mid-continental grassland biome has been greatly reduced and degraded throughout its range. Most grassland acreage has suffered one of the following fates: (1) conversion to crop production, (2) over-

grazing, or (3) invasion by shrubs and trees due to lack of fire, lack of grazing, or both. With productive soils and ample precipitation, the eastern portion of the grassland biome (including Wisconsin), known as *tallgrass prairie*, was thoroughly fragmented and almost totally converted to agricultural use. Tallgrass prairie and related oak savanna are now the most decimated and threatened plant communities in the Midwest and among the most decimated in the world.

**Table 7**

Rare and declining Wisconsin grassland plants. Compiled from Wisconsin Department of Natural Resources (1992).

| Status | Scientific Name | Common Name |
|---|---|---|
| **Extinct** | (none) | |
| **Extirpated** | *Asclepias meadii*** | Mead's milkweed |
| | *Platanthera blephariglottis* | white-fringed orchid |
| **Endangered** | *Agalinis skinneriana*** | pale false foxglove |
| | *Anemone caroliniana* | Carolina anemone |
| | *Anemone multifida* | Hudson Bay anemone |
| | *Astragalus crassicarpus* | prairie plum |
| | *Astragalus neglectus* | Cooper's milk vetch |
| | *Fimbristylis puberula* | chestnut sedge |
| | *Lespedeza leptostachya** | prairie bush clover |
| | *Liatris punctata* | dotted blazing star |
| | *Parnassia parviflora* | small-flowered grass-of-parnassus |
| | *Phlox glaberrima* | smooth phlox |
| | *Platanthera leucophaea** | prairie white-fringed orchid |
| | *Polygala incarnata* | pink milkwort |
| | *Prenanthes crepidinea* | great white lettuce |
| | *Prenanthes aspera* | rough white lettuce |
| | *Ruellia humilis* | wild petunia |
| | *Scirpus cespitosus* | tussock bulrush |
| | *Scutellaria parvula* | small skullcap |
| **Threatened** | *Agastache nepetoides* | yellow giant hyssop |
| | *Agalinis gattingeri* | round-stemmed false foxglove |
| | *Asclepias lanuginosa* | wooly milkweed |
| | *Asclepias sullivantia* | prairie milkweed |
| | *Cacalia tuberosa* | prairie Indian plantain |
| | *Cirsium hillii*** | prairie thistle |
| | *Cypripedium candidum*** | white lady-slipper |
| | *Echinacea pallida* | pale purple coneflower |
| | *Eleocharis rostellata* | beaked spike-rush |
| | *Hypericum sphaerocarpum* | round-fruited St. John's wort |
| | *Lesquerella ludoviciana* | bladderpod |
| | *Opuntia fragilis* | brittle prickly-pear |
| | *Parnassia palustris* | marsh grass-of-parnassus |
| | *Parthenium integrifolium* | wild quinine |
| | *Polytaenia nuttallii* | prairie parsley |
| | *Platanthera flava* | tubercled orchid |
| | *Tofieldia glutinosa* | false asphodel |

*Continued on next page*

According to the State Natural Heritage Inventory, Wisconsin has only 0.5% (13,000 acres) of its original grassland ecosystem remaining in a relatively intact condition, and much of this remnant acreage has been degraded to some degree by livestock grazing or woody invasion. Over 80% (11,000 acres) of this remaining acreage is sedge meadow, and the rest (2,000 acres) is native prairie. However, the inventory is not nearly as complete for sedge meadow as it is for prairie; there are many acres of secondary and small tract sedge meadows not included in the acreage total.

These remnants represent only 1.1% and 0.1% of the original sedge meadow and prairie acreage, respectively. Most of the surviving prairie is either dry or wet; the intermediate type (mesic prairie), once the most common type in the state, is now virtually gone. Only about 100 acres (0.01%) of an original million acres of mesic prairie are known to exist, and these are in small (often linear), scattered parcels of a few acres at best.

Wisconsin's grassland plants and animals responded to the changes that came with Euro-American settlement in various ways. Some species adapted well and maintain healthy populations today, while some are persisting only in low numbers. Others are restricted to prairie and sedge meadow remnants, and a few have been extirpated.

An estimated 15%-20% of the state's original grassland flora is now considered rare in the state. Seventeen species are currently on Wisconsin's endangered species list; 17 species are on the threatened species list; and 29 species are of special concern in the state (Table 7). This pervasive rarity among grassland plants is due to the extensive loss of the original grassland sod and the conservative nature of many grassland plants, which are rarely found outside of native vegetation remnants. Some, such as prairie gentian and hoary puccoon, are so conservative that

they are rarely if ever successful in restoration attempts.

The current rarity of many of these species is not limited just to Wisconsin but is also characteristic throughout their range. Three Wisconsin species, Mead's milkweed, prairie bush-clover, and prairie white fringed orchid, are on the federal list of threatened species, and six others, prairie thistle, glade mallow, tubercled orchid, prairie fame-flower, pale false foxglove, and eared false foxglove, are being considered for federal listing.

Most of Wisconsin's grassland vertebrates adapted to the changes in the land. Noted exceptions are the extirpated megafauna (i.e., bison, elk, and wolves), and smaller, specialized animals such as the ornate box turtle and the long-billed curlew. Species that did adapt made use of croplands, pastures, old fields, roadsides, and other highly altered, surrogate "grasslands." However, in the past few decades even these areas have declined in acreage and quality due to changing agricultural practices and land use (e.g., increased use of pesticides, extensive conversion of small grain and pasture acreage to row crops, and changes in the nature and timing of agricultural disturbances, including the early and frequent mowing of alfalfa) and invasion by woody growth into fence lines and open fields.

Some prairie mammals adapted to the initial loss of prairie vegetation and more recent land-use changes and are thus still doing well in Wisconsin today. These include the prairie mole, thirteen-lined ground squirrel, harvest mouse, and prairie deer mouse. Other species have not adapted well to the changes, and have been either extirpated as mentioned above or are now of special concern in the state. The special concern species include Indiana little short-tailed shrew, white-tailed jack rabbit, Franklin's ground squirrel, and prairie vole.

Grassland bird populations were substantially altered by Euro-American settlement. But because grassland birds are not strictly dependent upon native vegetation, they are one group that generally did not decline solely because of the loss of native vegetation. They are, however, sensitive to both the structure of vegetation (e.g., degree of treelessness, vegetation height and

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| Status | Scientific Name | Common Name |
|---|---|---|
| **Special Concern** | *Agoseris cuspidata* | prairie dandelion |
| | *Aristida dichotoma* | poverty grass |
| | *Artemisia frigida* | prairie sagewort |
| | *Callirhoe triangulata* | poppy mallow |
| | *Carex richardsonii* | Richardson's sedge |
| | *Carex suberecta* | prairie straw sedge |
| | *Carex torreyi* | Torrey's sedge |
| | *Cassia marilandica* | Maryland senna |
| | *Dasistoma macrophylla* | mullein foxglove |
| | *Eleocharis robbinsii* | Robbin's spike-rush |
| | *Eleocharis wolfii* | wolf spike-rush |
| | *Gentianopsis procera* | small fringed gentian |
| | *Houstonia caerulea* | bluets |
| | *Liatris spicata* | marsh blazing star |
| | *Napaea dioica* | glade mallow |
| | *Oenothera serrulatus* | toothed evening primrose |
| | *Orobanche ludoviciana* | Louisiana broomrape |
| | *Orobanche uniflora* | one-flowered broomrape |
| | *Panicum wilcoxianum* | Wilcox's panic grass |
| | *Penstemon hirsutus* | hairy beardtongue |
| | *Penstemon pallidus* | pale beardtongue |
| | *Petalostemum villosum* | villous prairie clover |
| | *Physalis grandiflora* | white ground cherry |
| | *Polygala cruciata* | cross milkwort |
| | *Psoralea argophylla* | silvery scurfy pea |
| | *Psoralea esculenta* | pomme-de-prairie |
| | *Solidago ohioensis* | Ohio goldenrod |
| | *Talinum rugospermum*** | prairie fame-flower |
| | *Tomanthera auriculata*** | eared false foxglove |

* Federally threatened. ** Concern at federal level.

**Table 7 (cont'd)**

Rare and declining Wisconsin grassland plants. Compiled from Wisconsin Department of Natural Resources (1992).

density, and amount of residual ground cover) and size of habitats, as well as to the nature and timing of agricultural disturbances mentioned above. Radical changes in these habitat features have been occurring over the past 150 years; often these changes have had direct or indirect ramifications for bird populations. For example, species with large minimum area requirements (area-sensitive species) such as sharp-tailed grouse, greater prairie-chicken, and short-eared owl, are not thriving today, in part because of the fragmentation and reduction of large habitat tracts.

> Little is known about the status of invertebrates in our native grasslands. In fact, there are probably dozens of grassland insects in Wisconsin still unknown to science . . . . Many species may have already been extirpated or become extinct without our having known of their existence.

Today, grassland bird species vary in their status. Of those that were historically present in Wisconsin, a few are still doing very well, often because they (1) are generalists that can use a variety of habitat types (e.g., red-winged blackbird, mourning dove, and song sparrow) or (2) have adapted to intensive row-crop agriculture (e.g., killdeer and horned lark). However, the status of most grassland birds is far less secure than that of these few species. A variety of species adapted well to the low intensity agriculture that occurred before the late 1950s, and they thrived until then. However, in the past 30 years many of them (e.g., bobolink, eastern meadowlark, field sparrow, and grasshopper sparrow) have begun to decline, due in part to the changes in land use and agricultural practices mentioned above. Other species, such as greater prairie-chicken and sharp-tailed grouse, did well after Euro-American settlement, but they did so partly by expanding their ranges into the vast logged and burned-over lands of northern Wisconsin. As the northern habitat grew back to forest, these species eventually declined as well.

As a result of a combination of factors including habitat changes over the past 150 years on breeding grounds, wintering grounds, or both, and habitat-related problems with nest productivity, 16 of Wisconsin's grassland bird species are now of special concern in the state (Table 8); one (greater prairie-chicken) is on the state's list of threatened species. In addition, three other grassland birds, whooping crane, long-billed curlew, and swallow-tailed kite, have been extirpated from the

**Table 8**

Rare and declining Wisconsin grassland birds.

| Status | Common Name |
|---|---|
| **Extinct** | (none) |
| **Extirpated** | whooping crane*<br>long-billed curlew<br>swallow-tailed kite |
| **Threatened** | greater prairie chicken |
| **Special Concern** | northern harrier<br>sharp-tailed grouse<br>upland sandpiper<br>short-eared owl<br>dickcissel<br>Henslow's sparrow<br>grasshopper sparrow**<br>Le Conte's sparrow<br>sharp-tailed sparrow<br>lark sparrow<br>bobolink**<br>western meadowlark**<br>yellow rail<br>Wilson's phalarope<br>sedge wren<br>northern pintail |
| **Declining** | savannah sparrow**<br>eastern meadowlark**<br>vesper sparrow**<br>field sparrow**<br>blue-winged teal** |

* Federally endangered.

**Declining in recent years based on federal breeding bird surveys conducted in Wisconsin.

state due in part to their inability to adapt to land-use changes and unregulated hunting. All three extirpated species now have reduced ranges, but none is extinct. One, the whooping crane, is federally endangered.

Only about one-half of Wisconsin's prairie-associated reptiles and amphibians are still at good population levels today. These include eastern tiger salamander, six-lined racerunner, blue racer, eastern plains garter snake, and Butler's garter snake. Like many other vertebrates, their success has been due to their ability to adapt to surrogate "grasslands." The rest of the prairie reptiles have not adapted as well and are apparently suffering from habitat loss and fragmentation. Of this group, three (ornate box turtle, western slender glass lizard, and massasauga rattlesnake) are on the state list of endangered species, one (Blanding's turtle) is on the state list of threatened species, and two (prairie ringneck snake and bull snake) are on a list of special concern in the state.

Little is known about the status of invertebrates in our native grasslands. In fact, there are probably dozens of grassland insects in Wisconsin still unknown to science. For example, a cursory search for leafhoppers at 14 Wisconsin prairie remnants in 1993 and 1994 revealed five leafhopper species new to science and 24 species never before recorded from the state (K.G.A. Hamilton, Agriculture Canada, Ottawa, pers. comm.). Many species may have already been extirpated or become extinct without our having known of their existence. In light of this ignorance and the fact that there are often close relationships between invertebrates and vegetation (e.g., host plant specificity at the species, genus, and family levels), many grassland invertebrates would be considered rare and endangered at both state and federal levels if distribution and population data were available. For example, some information is available about Lepidoptera (moths and butterflies); consequently, 19 grassland Lepidoptera are now on the state's list of special concern; two species, swamp metalmark and regal fritillary, are on the Wisconsin threatened species list (regal fritillary is also being considered for federal listing); and three species, Powesheik skipper, phlox moth, and silphium borer moth, are on the Wisconsin endangered species list.

If recognition, protection, management, and restoration are actively pursued and fostered at levels greater than they have been in the past, most of the biotic diversity of our original grassland ecosystems can be retained within the state over time. But time is running out fast. With each passing year, options for retention or recovery are lost at an accelerating rate, and the costs and efforts needed to retain grassland biodiversity increase.

## Projected

What remains of our native grassland systems has neither long-term nor short-term security. In the absence of additional recognition and management, grassland species and remnant vegetation will continue to be lost due to area reduction, fragmentation, isolation, and degradation (ecosystem simplification). However, if recognition, protection, management, and restoration are actively pursued and fostered at levels greater than they have been in the past, most of the biotic diversity of our original grassland ecosystems can be retained within the state over time. But time is running out fast. With each passing year, options for retention or recovery are lost at an accelerating rate, and the costs and efforts needed to retain grassland biodiversity increase.

## Actions Causing Concern

Threats to the future survival of our native grassland flora, fauna, and vegetation remnants can be summarized in six categories:

- Continued loss of native remnants (both high-quality sites and those moderately degraded by grazing) due to:
  - ✓ accelerating invasion by woody growth on both wet and dry sites (e.g., red cedar is now invading dry bluff prairie so fast that in 20 years most unmanaged bluff prairie remaining in the Midwest will be completely overgrown, and wetland shrubs and trees are increasingly taking over extensive areas of sedge meadow).
  - ✓ tree planting for "wildlife," "aesthetics," and timber/fiber production. (Planting trees into prairie remnants is a common practice, so as to make economic use of sites people perceive as being "worthless.")
  - ✓ public opposition to tree removal needed to restore or maintain grasslands.
  - ✓ rural home building; this is often focused on nonagricultural lands and, thus, prairie remnants.
  - ✓ conversion of traditional prairie pastures (unplowed but grazed prairie) to crops.
  - ✓ drainage and conversion of sedge meadow and wet prairie to muck farming.
- Continued loss of surrogate post-settlement "grasslands" used by grassland animals (especially birds), due to intensive agriculture and urban development.
- General lack of attention to native grassland communities by the public, resource managers, and scientists.
- Resistance to the use of prescribed fire and lack of understanding by the public and professionals of fire effects (i.e., the consequences of both too much and too little fire).
- Invasion by aggressive exotics (e.g., honeysuckle, common buckthorn, reed canary grass, leafy spurge, parsnip, purple loosestrife, etc.).
- Habitat fragmentation, which results in patch isolation and the creation of edge effects. This is especially harmful to vertebrate animals.

**[top]** Spring Green dry prairie seen in 1975 with the beginnings of red cedar invasion. *Photo by Bill Tans.*

**[bottom]** The same view of Spring Green dry prairie in 1991 with red cedar nearly covering the hillside. *Photo by Richard Henderson.*

## Socio-Economic Issues

Strong public support will play a vital role in retaining and regaining grassland biodiversity in Wisconsin. Management of the grassland ecosystem, or at least elements of it such as open treeless habitat for grassland birds, is compatible with many traditional wildlife management and hunter interests (i.e., species such as ring-necked pheasant, upland nesting ducks, sharp-tailed grouse, and prairie chicken). Livestock grazing and crop production are also potentially compatible with maintaining the open habitat structure needed by many grassland animal species. Agricultural and soil conservation programs, such as the Conservation Reserve Program (CRP), and water quality protection can also be very compatible with grassland habitat interests.

Strong public support will play a vital role in retaining and regaining grassland biodiversity in Wisconsin.

There is already some public awareness and interest in both prairie flora (as exemplified by the popularity of prairie restoration and landscaping) and grassland birds that are well known and popular with bird watchers, such as sandhill crane, prairie chicken, meadowlark, bobolink, Henslow's sparrow, and upland sandpiper. These combined interests should translate into public support for grassland habitat preservation and restoration. There is already much support among private conservation groups for prairie and sedge meadow protection and recovery; for example, mesic prairie is a top preservation priority for The Nature Conservancy; there is a new and growing regional conservation group called The Prairie Enthusiasts; and The Madison Audubon Society is supporting a large prairie restoration on land they hold.

## Potential for Community Restoration

Recovering and maintaining native grassland biodiversity in Wisconsin is very feasible for many but not all components (e.g., birds, plants, and invertebrates) of the system. It is unlikely that we will ever again be able to accommodate mega-fauna such as bison, elk, and wolves in a naturally functioning grassland ecosystem in Wisconsin.

Retention of grassland biodiversity will require more than just the preservation of existing high-quality remnants of native vegetation. Most remnants are less than ten acres in size and very few exceed 50 acres. They are just too small for many if not most vertebrate animal species. Small sites, however, are capable of supporting viable populations of most plant species, most soil microflora and microfauna, and many other invertebrate species for decades if not centuries to come, especially if the sites contain soil moisture gradients and are provided with buffer land.

Remnants degraded by grazing or woody growth invasion can also play a significant role. Degraded areas are much more common and often larger than high-quality remnants. Their value is in the residual species they still harbor and the great potential they have for recovery. Their condition is often such that recovery can be accomplished solely by brush removal, restrained grazing, or fire. The greatest opportunities for recovery of degraded sites are at the dry and wet ends of the soil moisture spectrum, where several thousand acres of degraded dry prairie and sedge meadow still exist.

Recovery of the mesic prairie system is a different situation. Because mesic prairie remnants of any quality are very rare, retaining or regaining components of this system will require extensive buffering of the few remaining remnants and much

Restoration will not be easy, and it will take much time, maybe even centuries, before the prairie community is significantly restored. However, restoration is feasible. Many elements of the system can still be found in forgotten corners of the landscape, and they can be brought back together with reasonable effort.

Mesic prairie remnant between hay and corn fields. Most mesic prairie has been converted to agriculture. The soil on which mesic prairies occurred is deep and fertile. Ipswich Prairie, Grant County. *Photo by Eric Epstein.*

restoration from scratch (i.e., on sites highly altered by tillage or other intense disturbance). Such restoration will not be easy, and it will take much time, maybe even centuries, before the prairie community is significantly restored. However, restoration is feasible. Many elements of the system can still be found in forgotten corners of the landscape and they can be brought back together (i.e., translocation of individuals or reintroduction by seed) with reasonable effort. As reduced and fragmented as the prairie ecosystem is in Wisconsin, local genetic variations of species, particularly plants and invertebrates, still survive in low numbers on the landscape. This genetic diversity can still be accessed for restoration. Although restorations should be viewed as long-term, they can, in as little as a decade, result in reasonable facsimiles of prairie that support far more biotic diversity than alternative grass covers such as brome or switchgrass.

Given the fragmented nature and small size of native remnants and even potential restorations, the main hope for grassland vertebrates lies with surrogate "grassland" habitat that does not necessarily have native vegetation. The opportunities for establishing this habitat are extensive on both private and public lands, especially DNR-managed lands. In many cases establishment would only require removal and control of woody growth. In others it would require the establishment of permanent grass/forb cover.

## Possible Actions

The following possible actions are consistent with ecosystem management, but require more analysis and discussion. How priorities are set within this list will be based on ecoregion goals, staff workload, fiscal resources, public input and support, and legal authority. We will work with our customers and clients to set priorities and bring recommendations to the Natural Resources Board for consideration beginning in the 1995-97 biennium.

Efforts at recovery and maintenance of grassland biodiversity in Wisconsin should focus on three general areas of concern: (1) bird, herptile, and small mammal communities that require large habitat areas but not necessarily native vegetation; (2) native community remnants (vegetation, soil, and invertebrates); (3) endangered or threatened animal species that have requirements for both native vegetation and large areas (e.g., ornate box turtle). Species in the latter category will need specific recovery plans, which are not addressed here. Possible actions that address the first two concerns are as follows:

1. Establish treeless grassland habitat at several landscape scales to meet area requirements for species ranging from the prairie chicken to the grasshopper sparrow. Examples of both lowland and upland habitats should be sought, and most projects should be in former native grassland areas. Rationale for the latter requirement is that historical grassland areas will have the soil, topography, remnant vegetation, lack of large trees, and climatic conditions most conducive to restoring and maintaining open grassland habitat. However, some regions of existing cleared forest or drained marsh may prove suitable as well.

   The total acreage of permanent grass/forb cover needed for maintaining viable populations of grassland birds in the state is unknown. At least 3%-4% (90,000-125,000 acres) of the original

acreage may be required. However, even more important than total acreage is the placement and configuration of these acres. The following three-part strategy is recommended:

**Large Landscapes.** Establish 4-5 landscape regions of at least 10,000 acres each that are as treeless and open in character as possible. Within each region there should be a core area of permanent grass cover that is at least 2,000 acres in size. Within the rest of the region there should be at least 35% permanent cover, 75% of which should be in units of 40 acres or more. The remainder (52% of total) can stay in crop production. Small grain and hay crops should be encouraged.

**Small Landscapes.** Establish 10-12 landscape regions of 1,000-5,000 acres each, with permanent cover cores of at least 250 acres and a 15% permanent cover over the rest of the region. Follow the same guidelines used in the large landscape regions.

**Scattered Tracts.** Establish numerous scattered grass/forb fields that are at least 20 acres in size when there are no edge effects from trees or other obstructions. If edged by trees, the minimum acreage should be 40 acres. Total acreage goals should be approximately 50,000 acres. When possible these fields should be placed in close proximity to other permanent grass/forb cover.

In the development of these "grassland" habitat areas, a variety of grass/forb cover types should be used. Incorporation of native remnants and restoration of native vegetation should be encouraged, but not made an absolute requirement. For more detailed habitat recommendations, see Sample and Mossman (1990). In addition, a Bureau of Research Technical Bulletin on grassland bird status and management is presently being written.

2. Manage, enhance, and restore native vegetation remnants as refugia for flora, invertebrates, and ecological processes. For the most part these efforts will be at scales far smaller than those used for the "grassland" habitat discussed above. However, some acreage overlap of the two programs is likely to occur and should be encouraged. Recommended strategies for maintaining and recovering the two major grassland types of the state—sedge meadow and prairie—are as follows:

   **Sedge Meadow.** The total acreage needed to ensure the long-term survival of the sedge meadow plant and invertebrate communities in the state is unknown. One to two percent (10,000-20,000 acres) of the original one million acres may be a reasonable target.

   Highest priority should be given to the protection, maintenance, and recovery of the largest and most intact examples. However, small, high-quality sites (as small as ten acres) should not be overlooked; such areas may represent the last refuge for many sedge meadow plant, insect, and soil microflora and microfauna species. Special priority should also be given to sedge meadows that are part of larger grasslands or wetland complexes.

   Once the high-quality sites are secure (including adequate buffer lands), degraded areas with high recovery potential should be considered for completing the acreage goals. Restoration of sedge meadow from scratch is not a desirable recovery strategy at this time, because of the adequate amount of remnant acreage that still exists and the great difficulties associated with sedge meadow restoration.

Curtis Prairie, UW Arboretum, an example of dry mesic prairie. Restorations such as this will be needed to meet the possible acreage goals for native grasslands restoration. *Photo by Richard Henderson.*

Buffer lands will be crucial to the long-term (100 years or more) survival of all prairie remnants, especially the smallest ones, and their dependent species.

**Prairie.** As with sedge meadow, the total acreage needed for long-term survival of the prairie plant and invertebrate communities in the state is unknown. Again, 1%-2% (21,000-42,000 acres) of the original 2.1 million acres may be a reasonable target. In the case of prairie, however, this goal is at least ten times greater than the total known acreage of all high- to moderate-quality prairie remnants combined, and it probably exceeds the combined acreage of all remnants, including degraded ones (i.e., remnants not included in the inventory). Therefore, some restoration from scratch will be needed to meet the acreage goal, preferably on buffer lands surrounding remnants.

Highest priority should be put on the protection and maintenance of all high-quality remnants of an acre or more in size, followed by degraded remnants of five acres or more. High-quality sites as small as 1-2 acres should not be ignored, especially when they contain mesic prairie, for they are probably the last refugia for many prairie plant, insect, and soil micro-organism species. In addition, because of the near total loss of prairie, these small remnants now collectively function as the repository for the genetic diversity of most prairie plants and invertebrates. These repositories must not be lost. Their genetic holdings will be needed in any future prairie restorations.

Buffer lands will be crucial to the long-term (100 years or more) survival of all prairie remnants—especially the smallest ones—and their dependent species. Buffer lands are needed to protect remnants against the negative impacts of external influences and stochastic events, and to provide living space into which the prairie community can spread and rebuild marginal populations. Ideally, buffer lands should also provide those portions of the soil-moisture spectrum not found in the remnant. In most cases this will be mesic soil. It would also be ideal to buffer remnants by including them in larger grassland bird habitat areas.

3. If we are serious about long-term retention of grassland biodiversity in Wisconsin, eventually we will need three or four large-scale restorations (greater than 1,000 acres) that encompass clusters of existing remnants. Such acreage is needed for natural landscape processes to occur. Having such areas will also eventually reduce management costs per acre; for the effort required to maintain a remnant community is inversely proportional to the size of the remnant.
4. The current DNR/DOT Native Plant Seed Program, which will be supplying local genotypes, must be encouraged and expanded if restoration on a large scale is to become feasible.
5. Whatever the final acreage goal for either surrogate "grassland" habitat or native remnant vegetation, it should include representation of a variety of soil and topographic types, as well as geographic locations. Based on historical occurrence, the total acreage goal should be shared among DNR Districts in the following approximate proportions:

| | |
|---|---|
| Southern District | 45% |
| Western District | 32% |
| Northwest District | 12% |
| North Central District | 5% |
| Southeast District | 5% |
| Lake Michigan District | 1% |

To reach these goals, some acquisition of private land will be needed, especially for remnant sites. However, much of Wisconsin's native grassland biodiversity can be maintained and regained without new land acquisition. Many opportunities exist for maintenance and recovery on land already managed by the DNR, especially in the programs of the Bureau of Parks and Recreation and the Bureau of Wildlife Management. Much could also be accomplished outside of DNR lands through cooperation and partnerships with other agencies (e.g., roadside programs) and private conservation groups. There are also many opportunities for encouraging surrogate habitat and remnant management on private lands through tax incentives (e.g., the Minnesota Prairie Bank Program), educational programs, agricultural programs (i.e., agricultural policy, farm bills, continuation of CRP and annual set-aside), technical advice and assistance, and the Habitat Restoration Areas component of the Wisconsin Stewardship Program.

6. Because of the current rarity and long-time absence of prairie on the landscape, a program of education/awareness is greatly needed for developing support for prairie recovery and maintenance. The Department's Bureau of Parks and Recreation and the Bureau of Information and Education should play major roles in this.

7. Develop a policy on prescribed burning that recognizes the dependence of some ecosystems, including grasslands, on fire and examines the resources and staff support necessary to effectively and safely use fire to manage these fire-dependent communities. In addition, air quality standards and policies within the Department's Division of Environmental Quality will need to be clarified.

A policy for prescribed burning that recoginzes the dependance of some ecosystems, including grasslands, on fire need to be developed. *Photo by Richard Henderson.*

8. Qualitative inventories of selected invertebrate taxa in remnants of prairie and sedge meadow and other grassland types (including non-native surrogates) are needed for the purpose of determining what specialized, remnant-restricted species still exist, their distribution, and their status. This information, which is currently lacking for the most part, would be of great assistance in setting protection and management priorities.

9. Much additional research is needed on the effects of grassland management techniques, such as burning, mowing, and grazing, on grassland vegetation and fauna. Obtaining this information will be crucial to our long-term ability to manage grasslands for the entire array of native grassland biodiversity.

10. Planning and coordination among all land management interests, especially within the DNR, is crucial, so that programs do not inadvertently cancel each others' efforts. For example, tree planting programs should strive to avoid destruction of prairie remnants or fragmentation of grassland habitat and, conversely, grassland habitat projects should avoid areas that are more appropriate for reforestation. Integrated management is the key to overcoming these types of management and policy conflicts.

## Case Study

# The Glacial Habitat Restoration Area: An Approach for Restoration of Grassland Communities

Contributed by Becky Isenring and Richard Henderson.

Native grasslands are among the most threatened natural community types in the state. Thus the Department faces a tremendous challenge in addressing the needs for restoration of these communities and preserving the native species in them. One approach that takes a step towards this end is the Glacial Habitat Restoration Area (HRA).

The primary objective of the Glacial HRA is to provide nesting habitat on a landscape scale for upland nesting waterfowl, native grassland non-game birds, and pheasants. This is to be achieved by restoring 10% of the land within a selected region of the state to a suitable condition. Restoration will be accomplished through a program of acquiring land rights through fee title and perpetual easements and then restoring the land to grassland and wetland habitat.

Innovations of the Glacial HRA project are its size and scope. The area covers 530,000 acres within the glaciated, former prairie/savanna area of southeast Wisconsin. Restoration goals are 38,000 acres of upland grassland habitat and 11,000 acres of wetland habitat distributed in small, scattered units (10-250 acres) within high priority sub-units of the entire HRA project area. The idea is to take an area of the state of manageable size and, applying research-based species management guidelines, reintroduce complexity into a simplified landscape. The priority sub-units were identified using Geographic Information System (GIS) analysis of three landscape habitat models developed for prairie waterfowl, native upland grassland birds, and pheasants. Any area that met the minimum criteria for at least two of the three habitat models became high priority for the programs restoration activities.

The Glacial HRA focuses on distributing most of the restoration into small scattered units (smaller than 100 acres). The largest unit goal is 250 acres, of which 12 are being sought within the total HRA. Restoration activities include planting native prairie species mix of 6-20 species.

The Glacial HRA program will do an excellent job of providing the scattered tract component of habitat for upland and wetland grassland birds. It will also meet some needs for native prairie restoration and protection of native sedge meadows.

In the process of implementing the Glacial HRA, Department managers are realizing that it can be used as a springboard into a program that does even more for grassland biodiversity needs. Some ideas being considered in statewide discussions include (1) making some management units larger (250-2,000 acres) because the program could go farther to meet the habitat needs of grassland birds, mammals, and reptiles if the restoration units were larger; (2) using seed from local sources and planting it in mixes of 80 plus species to increase benefits to include a broader range of wildlife species; (3) making native prairie remnants acquisition priorities so that the Glacial HRA would help to meet the total protection and restoration needs of native prairie vegetation, its associated soil communities, and prairie-restricted macro-invertebrates; and finally (4) having Department managers discuss how they can take what they have learned from the Glacial HRA and apply it to other areas of the state that have native prairie and sedge meadow restoration opportunities.

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